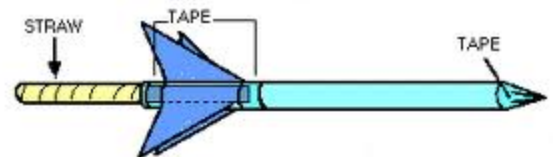


# **GTE, Middle, and High School Physics Grades 4-12**

## **Straw Rocket Inquiry Lab**

This is a fun inquiry lab in which students investigate the effect of fins on rocket flight. They make 4 identical paper tube rockets and then change the fin configuration to produce stable flight. Finally, they have to hit a target with their rocket.

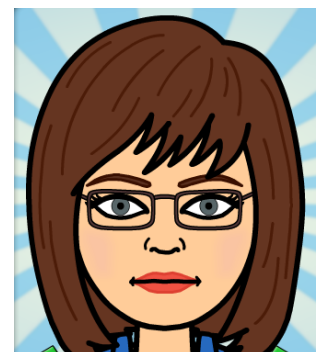
Expect it to take 20-30 minutes, but you can extend it by investigating the effect of the length of the nose cone or changing other variables. It costs pennies to do and you can get all the supplies at any grocery store. All you need are 1 clean straw per group, tape and or glue sticks, and colored or plain paper.



- Hands on experience
- Cooperative Learning
- Teacher instructions and set up
- Reinforcement of difficult concepts
- Student handouts including data table and graph
- Links to launchers you can build

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## Teacher Instructions

This is a 20-30 minute inquiry lab on rockets, stability, Newton's laws of motion, and turbulence. You can extend it for projectile motion as well. It costs pennies to do and you can purchase the supplies at a grocery store. You'll find a page of fins to print out if you'd like, a student data or collection page and student instructions.

You'll need for each team:

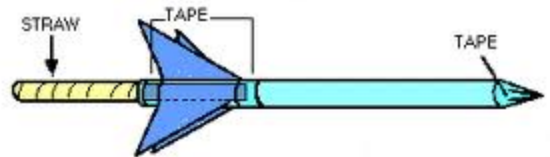
1 clean large plastic straw – it cannot be reused by other teams

2 sheets of colored paper

Good glue stick and clear tape

Print out of the fins if you don't want students to trace them.

Scissors



Set up a line of 5-7 meter sticks in the hall way or mark it with tape. Mark a starting position. The front or nose cone of their rocket should be BEHIND this line.

When students are done collecting their data, set up a target on the floor by drawing 3 concentric circles on a sheet of printer paper or bulletin board paper. Choose a moderate distance based on what you've seen happen with your students rockets. Then, offer a prize or bonus points if they can hit the target on the first try, without practicing.

**Note:**

The straw rockets need to be parallel to the ground when they are launched.

Remind students not to point them at each other!

If students struggle making the paper tube around a straw, have them do it around a pencil instead.

I build an entire rocket in front of the class and demonstrate a) how to use a glue stick b) how to burnish the paper down so that it will actually stick and hold c) how to wait 2 minutes for it to dry and d) how to make the taped nose cone. The nose cone works best if you flatten it and use a tiny piece of tape folded over it. You can have students try twisting the paper into a nose cone as well.

If you find that your students are really engaged with this activity, here are some ways to extend it:

- 1) Have them try different fin designs – longer and more narrow
- 2) Add a weight to the nose cone
- 3) Investigate the effect of the length of the nose cone. Have students twist the nose cone end to a point.
- 4) Design a launcher using a soft water bottle and stomping on it
- 5) Launch the rockets at an angle to study projectile motion
- 6) Eliminate the paper tube by using large plastic straws as the rocket body and a smaller straw for the launch
- 7) <http://www.instructables.com/id/Ultimate-Straw-Rocket!/>

Pitsco sells a straw rocket launcher, but this website offers you plans for a \$10 version of it: <http://test.fiddlersgreen.net/models/Aircraft/Piper-Cub.html>. This one allows you to launch at angles and everything.



And here is a simple plastic bottle version from Steve Spangler:  
<http://www.stevespanglerscience.com/lab/experiments/squeeze-bottle-rocket>



## The Lesson:

A rocket is a missile, spacecraft, aircraft or other vehicle that obtains thrust from a rocket engine. Most rocket engines carry propellants that are burned or combusted to give it thrust. A rocket moves forward by throwing this exhaust or burning gas backwards at a high speed.

The earliest rockets date back to 13<sup>th</sup> century China when saltpeter or gunpowder was developed. Today, rockets carry payloads into space like communication satellites.

In this activity, you'll be launching with air pressure, or a puff of air. The rocket will be a straw that is sealed on the nose end. When you apply a force, the rocket moves forward. This is Newton's third law of motion. For every action, there is an equal and opposite reaction.

Unlike a real rocket, your straw rocket will run out of energy in a hurry. It is an action reaction of short duration, not combustion of burning materials forming a hot exhaust. The harder the force (puff), the further the rocket will move. One of your issues will be to always use the same amount of air in the puff so that you can investigate the effect of fins on flight distance. Remember, in science, you only change one variable at a time.

The rocket will have a forward motion. You will measure the distance it travels horizontally and get an average for it, then test the effect of adding fins to the rocket.

You can test your rocket for stability by doing a drop test. Drop the rocket in a horizontal position. If the nose hits first, it's ready to launch. If the fin end hits first, it's not stable. You might need to adjust the fins a bit. Realize that stability is the point of the activity, so you may need to launch an unstable rocket and collect data on it.

This lesson:

- 1) students collect and graph data
- 2) investigate the effects of forces and motion, distance and position.
- 3) allows students to take measurements using the metric system
- 4) use mathematics to analyze data
- 5) use a graph to determine what happens in a physical event

If you like this free product, check out my other items at Teacherspayteachers.com.

Why pay for activities when you can find them on the internet for free? Because you get what you pay for! Free activities rarely have the lesson that goes with them or teacher instructions. My products are tested in my own classroom and include student handouts, data tables for lab books or

interactive notebooks, the science and why about the activity and a key if it's appropriate.  
Discrepant events may be fun, but they have to be tied to content and that's what I do for you.  
Enjoy this straw rocket activity!

Kelly Dunigan

Name(s): \_\_\_\_\_ Date: \_\_\_\_\_

### **Data Table:**

**Rocket 1 - No Fins**

Trial	Distance (m)
1	
2	
3	
average	

**Rocket 2 - 1 Fin**

Trial	Distance (m)
1	
2	
3	
average	

**Rocket 3 - 2 Fins**

Trial	Distance (m)
1	
2	
3	
average	

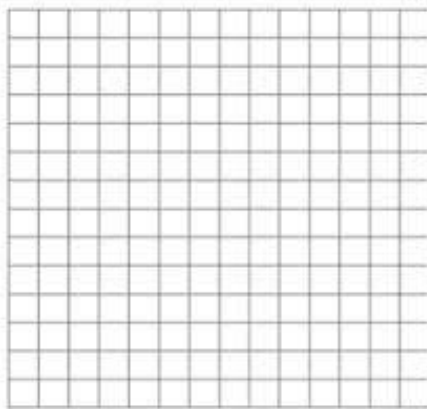
**Rocket 4 - 3 Fins**

Trial	Distance (m)
1	
2	
3	
average	

**Rocket 5 - 4 Fins**

Trial	Distance (m)
1	
2	
3	
average	

### **Graph of Distance on the y to # fins on the x:**

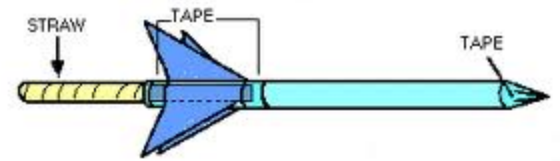


What does the graph mean? If possible, write a formula that describes your data:

### **Conclusion:**

- 1) What is the effect in fins on the flight distance of a straw rocket?
- 2) How could you determine the optimum number of fins for stable flight?

# **Straw Rockets and the Effect of Fin Configuration on Horizontal Distance**



Cut out four strips of paper about 2 1/2 inches wide and 8 1/2 inches long. It's useful to choose a color of paper that will allow you to identify your rockets easily.

Roll each strip around a large straw, but not too tightly. It needs to be able to slide off the launching straw easily. Choose someone to blow on the launcher straw. They should do all the launching so that a) all the launches are similar puffs of air and b) no germ sharing occurs.

Use a glue stick or tape to seal the rocket tube. Burnish it so it really sticks and then put it aside to dry. Make 3 more rocket bodies.



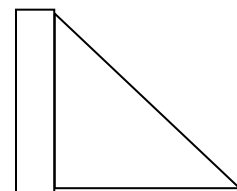
Flatten one end of each paper tube, then fold a piece of tape over it. This makes a crude sort of nose cone. Use only a small piece of tape and create a smooth end.

Take one finless rocket out into the hall where the meter sticks are set up and have the launching person stand just behind the first meter stick. Slide the paper tube onto the straw, and then should give a sharp puff to launch the rocket. Be sure the launcher is parallel to the ground. Measure the horizontal distance or range the rocket travels. Repeat this 2 more times and get an average. Record the information and make a statement about how the rocket flies, or its stability.



Did you notice that the Straw Rocket flies a short way and then starts to tumble in the air? Fins will help to stabilize the trajectory.

Use the pattern to the right to make fins for your rockets. Put them on the straw with a bit of tape or glue. You should reuse the first rocket by putting 2 fins on it. Put 3 on the next, 4 on the next one, and 5 fins on the final rocket. Take them out into the hall and collect the same data on them. Be certain to record the impact of fins on the stability of the trajectory.



Finally, choose the best and most stable rocket and take it to the launching area. Can you hit the target?

Complete the data table, graph and answer the questions.

**Have fun, but be safe!**



